ABSTRACT

Keywords: wheat, fertilizers, biostimulators, phase of vegetation, protein

The wheat is one of the most important plants that was cultivated because it has a lot of uses: for humad food, for animal food and for industrial proceess. Its importance for the human alimentation comes from the fact that the bread made from wheat flour represents abasic food for half of the world.

The doctorate thesis entitled ***"The effect of the fertilizers and biostimulators upon quantitative and qualitative production of winter wheat in the environmental conditions of the Moldavian Plain"*** has nine chapters with 225 pages, 137 tables and 23 figures. The thesis has two different parts: first part contains a synthesis of the bibliographic data about the doctorate thesis. This part has 73 pages and 12 tables.

The second part presents: the natural conditions, climatic conditions from the experimenting years, the material and the method of research and the results of my own research about the doctorate theme. This part has 152 pages, 125 tables and 23 figures.

The experiment was made on two agricultural years (2008-2009 and 2009-2010) in the Didactic Farm Ezăreni, which is in Iaşi county.

In the two experimenting years the temperature and the rainfall were very different.

In the fall of 2009-2009 the climatic conditions were favorable for the germination process, there were 12.2°C in october and 5.7°C in november.

The humidity was adequate, which was good for the emergence and tillering process.

During the vegetation period the rainfall didn't exceed the multiannual average, but alongside the high temperature the conditions for the wheat vegetation were unfavorable.

In 2010, during the vegetation period the average temperature exceeded the multiannual temperature, and the rainfall and humidity were higher, which made the harvesting harder, and it appeared the sprouting in ear phenomenon, which resulted in production losses.

The soil type on which the experiment was made was cambric chernozem with medium or medium soft texture, well defined glomerular structure which had a good penetrability for water and air and also average rate of hydrophysical coefficient.

The purpose of the research was to establish the possibilities for the usage of biostimulators and of the optimum dose for the fertilizers in order to obtain higher quantities of total and principal biomass with superior biochemical properties which concur to providing the population enough food of higher quality. The objectives of the research were: establishing the

fertilization effect with different doses of nitrogen, phosphorus and potassium on the production and on the quality of the wheat caryopsis; quantification of the biostimulators on the biomass production and on the content of protein, wet gluten and other quality indicators in the caryopsis; establishing the influence of the ecologic factors in the experimenting years on the wheat production and determining the economic efficacy of the obtained results.

To accomplish these objectives it was usedan experiment with tree factors of 5 x 3 x 3 with four repetitions. The researched factors were: A factor-fertilization with 5 stages: unfertilized ($N_0P_0K_0$), $N_{60}P_{60}K_{60}$, $N_{90}P_{90}K_{90}$, $N_{120}P_{90}K_{90}$ and $N_{160}P_{90}K_{90}$; B factor – biostimulators with tree stages: BCO 4DMA, BCO 4K and BCO 2K; C factor – aplication of biostimulators biophase with 3 stages: tillering, heading and full flowering.

The used biostimulants are from fenofialchil carboxil sulfoamidat acids which had the form of original salts, containing the group of alchilamin sulfonamidic. These have a large action spectrum which include biostimulators effects, growth and auxinic regulators which are not toxic for humans, bees, fish, are not cumulative but biodegradable.

The biostimulators were applied according to the trial protocol, in 625 l/ha, with a concentration of 25 ppm.

During the vegetation period it was observed the date of the springing, of the tillering, the flowering and the caryopsis forming period.

After the harvesting the determination of the ear numbers for the m², the number of the caryopsis and their weight in the ears was determined and the interpretation results were made trough variant analysis.

The mass of 1000 grains, the hectolitric mass and the quality indicators (the content of protein, wet gluten, falling and deforming indicators) were established in the laboratory.

In the agricultural year 2008-2009 the highest density of the spike on m² was on the version fertilized with $N_{90}P_{90}K_{90}$where the biostimulator BCO 2K was applied in the tillering (502 spike/m^2) and full flowering (500 spike/m^2) biostage.

A lower value of harvested grain, 434 spike/m^2, was registered in the unfertilized version when the biostimulator BCO 4 DMA was applied in the tillering biostage, this being the control version.

When in the agricultural year 2009-20010 the biostimulator BCO 4K was applied in the full flowering biostage on the $N_{120}P_{90}K_{90}$ agrofond was obtained the highest number of ears on m^2, of 582, the difference towards the control being of 124 ears/m2,very significant.

The interaction between the tree factors had a positive influence on the wheat plants height. After tree interactions, in the agricultural year 2008-2009 were obtained significant

differences ($N_{120}P_{90}K_{90}$ x BCO 4K x flowering; $N_{160}P_{90}K_{90}$ x BCO 2K x tillering; $N_{90}P_{90}K_{90}$ x BCO 4 DMA x full flowering), between 6.5 and 6.1 cm. The lowest hight was registered on $N_{160}P_{90}K_{90}$ x BCO 4 DMA x heading, 61.5 cm and $N_{60}P_{60}K_{60}$ x BCO 4K x full flowering, 60.9cm.

Although in the description of the Boema breed is said that the plant height is of 82 cm, in the agricultural year 2009-2010 we obtained a maximum height of 72.5 cm. A lower height leads to a better resistance to fall and hence the posibility to apply higher quantities of fertilizers which can positively influence the caryopsis production value.

The higher number of caryopsis was obtained in the agricultural year 2008-2009 on $N_{160}P_{90}K_{90}$ version, 29.9 caryopsis/ear. Equal values, of 29.5 caryopsis/ear were obtained in the fertilised versions $N_{120}P_{90}K_{90}$and $N_{60}P_{60}K_{60}$. Analizing the interaction influence of the tree factors on the caryopsis number in the ear we observe that it declined with 0.2 to 7.5 at the majority versions towards the witness version ($N_0P_0K_0$ x BCO 4 DMA x tillering), where it was obtained 33.1 caryopsis/ear.

Higher values registered when the biostimulator BCO 2K was applied in the heading biostage at the fertilized versions, $N_{90}P_{90}K_{90}$ and $N_{120}P_{90}K_{90}$ where were obtained 33.4 and 33.3 caryopsis/ear.

The fertilization influenced the weight of caryopsis on the ear. In the versions where the doses of $N_{160}P_{90}K_{90}$, $N_{120}P_{90}K_{90}$ and $N_{60}P_{60}K_{60}$were applied, there were obtained 1.37g, with a difference of 0.21g, very significat toward the unfertilized witness version, in the agricultural year 2008-2009.

Extraradicular application of the BCO 2K biostimulator lead to the growth of caryopsis weight in the ear with 0.10 toward the control version, the difference being significant. In the versions treated with BCO 4K and BCO 4 DMA biostimulators were obtained values close to the weight of the caryopsis in the ear, 1.34 and 1.28g.

In the agricultural year 2009-2010 the higher number of caryopsis on the ear, 29.6 was obtained on the fertilized with $N_{90}P_{90}K_{90}$ version and the highest weight was obtained when it was applied the highest dose of fertilizer. The lowest number and the lowest weight of the caryopsis on the ear were obtained on the unfertilized version.

In the experimenting conditions of the agricultural year 2009-2010, the highest number of caryopsis was obtained at the interaction between the $N_{60}P_{60}K_{60}$x BCO 2K x full flowering, the difference of 7.5 caryopsis/ear toward the control version being significant. At the same interaction was obtained the lowest weight of the caryopsis on the ear, 1.035g.

The radicular fertilization and the extraradicular application of the biostimulators at the

winther wheat brought a significant increase of production in each of the two years of experimenting on the field, but also as an average on the full period.

The caryopsis production was influenced by the climatic conditions of each year, but also by the technologic factors.

The highest production on the agricultural year 2008-2009 was obtained at the dose of $N_{90}P_{90}K_{90}$, 6428 kg/ha, and the lowest productionwas obtained at the unfertilized version $N_0P_0K_0$ (5220 kg/ha), followed by the doses of $N_{60}P_{60}K_{60}$, 6246 kg/ha, $N_{160}P_{90}K_{90}$, 6014 kg/ha and $N_{120}P_{90}K_{90}$, 5790 kg/ha.

The application of biostimulator from sulfamoil-fenoxialchil carboxylic acids lead to the growth of the caryopsis production.

Extraradicular application of BCO 2K biostimulator had as an effect the growth of production with 431.7 kg/ha towards the control version, the difference being very significant.

The BCO 4K biostimulator realized a production of 5927.9 kg/ha and the witness (BCO 4 DMA) obtained 5730.7 kg/ha.

At the interaction between the agrofund and the application stage of the biostimulator on the production of caryopsis in the agricultural year 2008-2009 we observed highest productions on the agrofunds of $N_{90}P_{90}K_{90}$ when there were applied biostimulators in the heading and tillering biostages and in the unfertilized version when there were applied biostimulator in the full flowering and heading stages (6489.4 kg/ha and 6391.6 kg/ha).

In the 2010 year, in the forming and filling the grains period, the temperature of the air was of 16.1°C in june and the rainfall was higher than the multiannual average, thereby there existed favorable conditions for the obtaining of higher production.

Because some of the nitrogen fertilizers were applied in the spring, it caused the increase of the caryopsis production.

At the versions where the nitrogen fertilizers were applied in the spring ($N_{120}P_{90}K_{90}$ and $N_{160}P_{90}K_{90}$) were obtained differences between 899.0 and 1064 kg/ha toward the witness, and the increase obtained on 1 kg of fertilizer was of 2.96 kg caryopsis.

At the versions where the fertilizers were applied at the preparing of the germinal layer, the quantity of water was sufficient, the wheat plants valued the fertilizers obtaining productions of 6803 kg/ha ($N_{60}P_{60}K_{60}$) and 6748 kg/ha ($N_{90}P_{90}K_{90}$).

At the interaction between the fertilizers and the biostimulators it can be observed that in the versions where there were no fertilizers, although biostimulators were applied, the production increase is insignificant. This proves once again the importance of the application of the fertilizers for the increase of the production of the wheat culture, the biostimulator having effect

only when there are enaugh nutritive substances in the soil.

At the application of the BCO 2K biostimulator, at the fertilized with $N_{60}P_{60}K_{60}$ version was obtained the highest production of caryopsis, 7799.7 kg/ha, the difference toward the witness being very significant.

On average, on the two studied years, on the first place was the fertilized with $N_{90}P_{90}K_{90}$version, where there were obtained 6588 kg/ha, followed by the $N_{60}P_{60}K_{60}$ version, 6524 kg/ha, the differences toward the unfertilized witness being very significant.

The applied biostimulators influenced the autumn wheat production in each of the two years, and the average. At the application of the BCO 4 DMA biostimulator, the production increase was of 1073 kg/ha, and at the application of the BCO 4K biostimulator of 1097 kg/ha, the difference toward the witness treated with water being very significat. The differences above 1000 kg/ha obtained after the application of the biostimulators mark out the role of these substances for the obtaining of higher production of caryopsis.

The analysis of the average results on the two years on the interaction between the tree factors: fertilization, biostimulators and the biostage of these applications gives us the possibility to recomend the interactions at which the production value was higher. On the first tree places are: $N_{60}P_{60}K_{60}$ x BCO 2K x heading, $N_{120}P_{90}K_{90}$ x BCO 4K x full flowering, $N_{60}P_{60}K_{60}$ x BCO 2K x full flowering with 2554, 2515 and 2395 kg/ha caryopsis.

Of the quality indicators estimated by the actual standards, in our research we approached: MMB, MH, the content of protein in caryopsis, the content of wet gluten, falling indicators, deforming indicators, glutemic indicators.

In the agricultural year 2008-2009, the highest value of MMB was obtained in the fertilized with $N_{60}P_{60}K_{60}$ version, 44.3g. Extraradicular application of the biostimulator substances lead to the increase of MMB with 1.1 g at the version treated with BCO 2K toward the control version (BCO 4 DMA), the difference being very significant.

In the agricultural year 2009-2010, the highest value of MMB was obtained in the fertilized with $N_{160}P_{90}K_{90}$version, 43.4 g, with a difference toward the witness of 1.2 g. Equal values, of 42.2 g were obtained in the fertilized with $N_{60}P_{60}K_{60}$ version and at the version where there were not applied fertilizers.

The MH is used as an indicator of quality in cereals in many countries, which leads to the value of the price. The fertilization with different doses of nitrogen in the agricultural year 2008-2009 influenced the MH. Thus MH increased from 76.2 kg/hl in the witness version ($N_0P_0K_0$) to 78.2 kg/hl at the fertilized with $N_{160}P_{90}K_{90}$version, the difference of 2 kg/hl being very significant.

The influence of fertilization in the agricultural year 2009-2010 on the MH mark out the dose of $N_{160}P_{90}K_{90}$with the value of 78.7 kg/hl, and the lowest MH was obtained at the dose of $N_{60}P_{60}K_{60}$and in the unfertilized version, 77.0 kg/hl.

The application of fertilizers mark out the increase of the protein procent in the caryopsis, from 12.3% at the fertilized with $N_{60}P_{60}K_{60}$ to 14.9% at the one with the lowest dose ($N_{160}P_{90}K_{90}$), the difference toward the witness, of 2.6% being very significat, in the agricultural year 2008-2009.

The equal values obtained at the fertilized version with the lowest dose and at the unfertilized version shows that for the obtaining of quality grains, with over 13% protein, the fertilizers doses have to be higher.

In the agricultural year 2009-2010 the content of protein in the fertilized with $N_{160}P_{90}K_{90}$version was of 14.3%, the quality of caryopsis, under this aspect being considered very good. At the unfertilized version, the witness, the protein procent was of 11.1, satisfactory.

The influence of fertilization on the content of raw protein, as an average on the two years show that the dose of $N_{160}P_{90}K_{90}$ at which the content of caryopsis protein was of 14.5%. It can be observed that along with the increase of the doses of fertilizers applied to the content of protein of the caryopsis increases as well.

In the agricultural year 2008-2009, the percent of protein from the caryopsis after the application of the biostimulators was higher that in the agricultural year 2009-2010, and as an average, on the two years were obtained values equal to the application of BCO 2K and BCO 4K, of 13.3%.

Fertilizers applied on doses of $N_{120}P_{90}K_{90}$ and $N_{160}P_{90}K_{90}$ had a favorable effect on the content of gluten, having values of 29.9% and 30.8%, the wheat being of good quality. At the same versions of fertilization, the values of the deforming and falling indicators subsumed in the very good quality class (3-13 mm, 220-260 sec.) After the evaluation of the gutemic indicator it was observed that the flour can be used for bread manufacturing because it subsumed in the interval between 40-59%. At the unfertilized version the wet gluten percent was lower, 24.8%, the wheat was of good quality and could be used in bread manufacturing after the addition of ameliorators.

The interaction between the tree factors, in the agricultural years 2009-2010 shows that from the content of wet gluten point of view, the caryopsis have a very good bread manufacturing quality. At 18 interactions the value of wet gluten excedded the threshhold of 26%. If we take the lower threshold of wet gluten content accepted for bread manufacturing (22%), we can see that no interaction obtained lower values. The deforming indicator had values

between 6.9 mm and 8.8 mm, which is very good. Under the aspect of falling indicator, 24 from 45 interactions obtained a falling indicator between 220-260 sec., which is very good.

At the fertilization with $N_{160}P_{90}K_{90}$ and the interaction with BCO 2K x headig stage was registered a higher value of production of 5158.3 lei/ha and 3590.3 lei/ha expensses, 0.487 lei/ha, a good profit of 1568 lei/ha and a rate of 43.67%.

Knowing the best values resulted from research we can choose the most appropiate interactions according to the possibilities of obtaining higher values of production, lower cost on the kilogram of product, a high profit and a convenient profit rate.

In the laboratory, at the Boema wheat breed was followed the effect of different biostimulators on the germinal energy, germinal capacity, the lenght of the embryo root and of the coleptilus, different concentrations of biostimulators, the treatments were done in four repetitions.

The biostimulators which were used are: BCO 2 DMA, BCO 4 DMA, BCO 2K, BCO 4 K, BCO 2 DMA + zinc acetate, BCO 4 DMA + zinc acetate, BCO 2K + zinc acetate, BCO 4K + zinc acetate.

The biostimulators were used in the next concentrations: 5 ppm; 10 ppm; 12.5 ppm; 16.66 ppm; 20 ppm; 25 ppm; 33.33 ppm; 50ppm.

Determinations of the phisiologic characteristics of the wheat caryopsis and biometric measurments on the roots and coleptil were made.

After the treatments on the wheat caryopsis made with biostimulators there were obtained equal values on the germinal energy and germinal capacity. The highest value of germinal energy was obtained at the version treated with the BCO 4K biostimulator, 92.12%. The witness version, treated with water registered the lowest value of germinal energy, 88.00%

At the application of the biostimulators in concentration of 12.5 ppm was obtained the smallest lenght of the embryo root, with 11.55 mm smaller than the witness version. The longest lenght was of 139.80 mm at a concentration of 16.66 pmm.

The lenght of embryo roots was almost equal when the caryopsis were treated with biostimulators and zinc acetate in a concentration of 25.00 and 20.00 ppm. Once the concentration decreased, the lenght of embryo roots decresed as well, the longest lenght was obtained at the version treated with biostimulators at a concentration of 50 ppm, 121.75 mm.